420 Earth (Geology and Soils)

Key to Icons

Memorandum of understanding, memorandum of agreement, or interagency agreement.

Reference document, such as a manual, book or published article.

Permit or application for a permit, approval or certification.

Web site.*

420.01 Introduction

Many of WSDOT's projects involve the movement or alteration of earth. Understanding the geology and soils is critical in safely designing the project. Likewise, it is important to recognize and understand a project's relationship to subsurface water conditions that might affect soil moisture, water supplies, wetlands, water movement, and project construction activities. Groundwater topics are addressed in **Section 433**.

This section describes the types of studies required. Elements for discussion include geology, soils, topography, unique physical features or landforms, and erosion potential. The consideration and analysis of earth-related issues is primarily related to impacts expected during construction.

(1) Summary of Requirements

The *Design Manual* (M 22-01) and applicable engineering standards require geotechnical explorations and soil investigations prior to developing the preliminary designs. These reports are also necessary to provide information for NEPA/ SEPA documents.

Preliminary route/design studies (when there is a need for selecting new routes and for evaluating design alternatives) include determining controlling factors within the project area such as terrain and geological structures. Terrain classifications are used in developing geometric design (see the *Design Manual* (M 22-01), Sections 310.03 and 440.05). Projects involving water-oriented construction or operation activities may require analysis of erosion of shorelines and nearshore features induced by water and/or vessel wake.

Investigation of soils and surfacing materials is addressed in Chapter 510 of the *Design Manual* and is discussed in more detail below.

(2) Acronyms and Abbreviations

Abbreviations and acronyms used in this section are listed below. Others are found in the general list in the appendix.

SSP	Stormwater Site Plan
TESC	Temporary erosion and sedimentation control

(3) Glossary

None.

* Web sites and navigation referenced in this section are subject to change. For the most current links, please refer to the online version of the EPM, available through the EAO home page: http://www.wsdot.wa.gov/eesc/environmental/

420.02 Applicable Statutes and Regulations

(1) National Environmental Policy Act/ State Environmental Policy Act

The National Environmental Policy Act (NEPA), 42 USC Section 4231, requires that all actions sponsored, funded, permitted, or approved by federal agencies undergo planning to ensure that environmental considerations such as impacts to the earth are given due weight in project decision-making. The State Environmental Policy Act (SEPA), mandates a similar procedure for state and local actions. Federal implementing regulations are at 23 CFR 771 (FHWA) and 40 CFR 1500-1508 (CEQ) State implementing regulations are in WAC 197-11 and WAC 468-12 (WSDOT). For details see **Section 410** through **Section 412.**

(2) Local Regulations

Local sensitive or critical areas ordinances may identify areas with high potential for erosion, subsidence, or instability. Local building codes typically require that construction practices are consistent with protection measures appropriate to the seismic risk designation for the project area. Local approval for development and operation of borrow pits may also be required.

420.03 Policy Guidance

The Transportation Commission's Policy Catalog includes no policies specifically referring to geology and soils. For other environmental policies, see WSDOT's home page:

http://www.wsdot.wa.gov/

Click on Transportation Commission, then Reports and Plans, then Policy Catalog.

Or by direct link:

http://www.wsdot.wa.gov/commission/ReportsPlans/Catalog.pdf

It is WSDOT's responsibility to understand the characteristics of subgrade material to ensure that the highway when designed will be adequate to safely carry the estimated traffic. It is also the responsibility of WSDOT to ensure the quality and quantity of all borrow materials used in the construction of highways or highway facilities See *Design Manual,* (M 22-01) Chapter 510.

420.04 MOUs, MOAs, and IAs

No interagency agreements specifically related to geology and soils were identified.

420.05 Technical Guidance

(1) WSDOT Discipline Report

WSDOT's Geology and Soils Discipline Reports provide the information required for EAs, EISs and other environmental documents. A checklist to guide preparation of these reports is given as **Exhibit 420-1**. Lengthy technical reports used to prepare the Discipline Report or other geology and soils investigations performed during preliminary design should be placed in an appendix to the EA or EIS.

Major sections of the Discipline Report are: Studies and Coordination; Affected Environment; and Impacts, Mitigation, and Construction Activity Impacts.

(a) Affected Environment

Consider project geology, geological hazards, topographic setting, unique physical features, and existing sundry sites.

Data for this section may be obtained from a variety of sources including WSDOT's GIS Workbench. This GIS interface is for internal WSDOT use only. It has over 60 layers of environmental or natural resource management data. The program works with federal, state, and local agencies to maintain a collection of the best available data for statewide environmental analysis. WSDOT users can access the State Soil Geographic (STATSGO) data set and others at:

w:\Data\GIS\GISOSC\GEODATA

For a list of current data sets, see WSDOT's environmental web site:

http://www.wsdot.wa.gov/eesc/environmental/

Click on Information, then WSDOT GeoData Catalog

Or by direct link:

http://www.wsdot.wa.gov/mapsdata/geodatacatalog/default.htm

(b) Impacts

This section should include potential for landslides, erosion/accretion, and settlement, as well as indirect impacts of the project, such as increased growth.

(c) Mitigation

Describe mitigation measures, commitments, and monitoring procedures. Also discuss mitigation measures considered or available but not included, with reasons why.

(d) Construction Activity Impacts

All impacts associated with construction of the project are to be addressed in the "Construction Activity Impacts" section of the EIS. Potential impacts may include erosion or accretion, and may include impacts related to haul routes and requirements for sundry sites.

Mitigation measures considered and proposed should also be described.

(2) Temporary Erosion and Sedimentation Control Plan

For guidance in preparing the Temporary Erosion and Sedimentation Control (TESC) Plan, refer to WSDOT's Temporary Erosion and Sediment Control Plan Checklist in **Exhibit 431-7**.

(3) Soils Surveys

The *Design Manual* (M 22-01), Chapter 510: Investigation of Soils and Surfacing Materials, contains detailed criteria for soil surveys to determine soil suitability and construction requirements, and material source investigations to ensure the quality and quantity of all borrow materials. The Materials Branch evaluates the information to prepare a report giving the required surfacing depths for the various subgrade soils. The report also includes recommendations for slope construction; maximum slope gradients in cuts and fills; treatment of slide areas, soft foundations, unsuitable soils, detrimental groundwater, and other unusual conditions; hiring a consultant to monitor the driving of piles in vibration and/or noise sensitive areas; and suggestions for the best use of available materials.

Design requirements for retaining walls and steep reinforced slopes are addressed in Chapter 1130 of the *Design Manual*. Soil investigations are required, and the structural elements of the wall or slope and the soil below, behind, and/or within the structure must be designed together as a system. Guidelines for wall/slope selection including cut and fill considerations, and settlement and deep foundation support considerations are provided in Chapter 1130.05.

(4) Erosion Control

Erosion is the major environmental issue related to soils. The movement of soil is usually detrimental to facilities as well as the environment, and is often the focus of water quality concerns, including prevention of sedimentation in streams and other water bodies.

WSDOT's *Highway Runoff Manual* (M 31-16) contains approved methods of managing stormwater runoff from WSDOT facilities. For erosion control and sedimentation requirements, see Chapter 2 and Chapter 6. Erosion prevention and sediment control are also addressed in WSDOT's *Roadside Manual* (M 25-30), Chapter 710.

Please refer to **Section 431.05** and **Section 431.06** for technical guidance and permits related to erosion and sedimentation.

(5) WSDOT Training

A training course on Erosion Control (Course Code: BPW) is available for WSDOT employees as part of WSDOT's Automated Training Management System (ATMS). WSDOT also offers two-day workshops to help staff prepare and implement effective TESC plans. This course also fulfills requirements for the Certification in Construction Site Erosion and Sediment Control and Erosion Control Lead General Special Provision (GSP) to the Standard Specifications for Road, Bridge, and Municipal Construction. For details, see the EAO web site:

http://www.wsdot.wa.gov/eesc/environmental/

Click on Hazardous Materials, then Training.

Or by direct link:

http://www.wsdot.wa.gov/eesc/environmental/programs/hazwqec/haz_training.htm

420.06 Permits and Approvals

Permit requirements relating to erosion or sedimentation are addressed under **Section 431.06**. In addition, the permits described below may be required.

(1) Grading

Whenever WSDOT construction entails a change in street grades in an incorporated city or town, the state is obligated by law to present the plans for new grades to the municipality for adoption by ordinance. On limited access facilities, no grade approval is usually required for the highway itself. However, plans must be submitted to any incorporated city or town for grade approval for connecting streets, frontage roads, streets outside the limited access, and streets or connections within interchange areas, including any road passing over or under the facility but having no connection to it. See *Design Manual* (M 22-01), 240.13(2).

(2) Critical Areas Ordinance

If a local jurisdiction's designated "critical area," such as a geologic hazard area, would be affected by a WSDOT project, the local jurisdiction may have authority under the Growth Management Act to require WSDOT to obtain a grading permit or other approval.

(3) Borrow Pits

Borrow pits may require permits or easements from the land-managing agency. On federal land, an easement or permit may be required from the U.S. Forest Service or Bureau of Land Management. The Washington State Department of Natural Resources has responsibility for Pit Site Reclamation Plans and Surface Mining Permits.

420.07 Non-Road Project Requirements

For ferry-related projects, the Geology and Soils Discipline Report should also address potential for shoreline erosion/accretion during construction and operations, underwater marine sediments, and geology. Geotechnical reports prepared for ferry projects should include a complete description of the top two feet of sediments, including grain size, composition, and percent composition.

For other non-road projects, the requirements would be the same as for road projects.

420.08 Exhibits

Exhibit 420-1 – Geology and Soils Discipline Report Checklist.

Washington State Department of Transportation

Discipline Report Checklist
Geology and Soils

Project Name: _____ Job Number: _____

Contact Name: _____

Date Received: _____ Date Reviewed: _____ Reviewer: _____

(SAT = Satisfactory; INC = Incomplete; MIS = Missing; N/A = Not Applicable)

Answers are required for questions which have no N/A box.

I. Studies and Coordination

(Refer to *Design Manual*, Chapter 510.)

Included the sources of information used, such as:

SAT	INC	MIS	N/A		
❒	❒	❒	❒	A.	U.S. Geological Survey maps; Department of Natural Resources Division Geology and Natural Resource Geologic Maps.
❒	❒	❒	❒	B.	National Resource Conservation Service County Soil Survey.
❒	❒	❒	❒	C.	Department of Ecology's Coastal Zone Atlas of Washington
❒	❒	❒	❒	D.	County Geologic Hazard and Sensitive Areas maps; Department of Natural Resources Division Geology and Natural Resource Geologic Maps.
❒	❒	❒	❒	E.	Published reports, studies and boring logs from past projects and adjacent development.
❒	❒	❒	❒	F.	Field review of site.
❒	❒	❒	❒	G.	Included the appropriate federal, state, and local agencies and tribes coordinated with.

II. Affected Environment

Discuss as appropriate:

SAT	INC	MIS	N/A		
❒	❒	❒		A.	General topographic setting and unique physical land features.
❒	❒	❒	❒	B.	Project geology including engineering geology characteristics of soils and rock, and the locations of soft and firm soil areas, and rock.
❒	❒	❒		C.	Geologic hazards identified such as regional faulting and potential seismic events, and possible earthquake secondary effects (e.g., liquefaction, ground motion amplification, tsunamis and seiches), existing or ancient landslides, areas prone to flooding, potential rock fall conditions, potential eruptive volcanos and their debris flow paths.
❒	❒	❒	❒	D.	Existing sundry sites (e.g., stockpile sites, waste sites, equipment staging areas).

III. Impacts

Consider impacts caused by indirect effects of the project, such as increased growth. Also consider:

SAT	INC	MIS	N/A		
❒	❒	❒	❒	A.	Cut, fill, and landslide slope stability.
❒	❒	❒	❒	B.	Structure foundation construction.
❒	❒	❒	❒	C.	Relationship between topography and alignment design.
❒	❒	❒	❒	D.	Potential for settlements.

IV. Mitigation

Included:

SAT	INC	MIS	N/A		
❒	❒	❒	❒	A.	Mitigation measures, commitments, and monitoring procedures.
❒	❒	❒	❒	B.	Mitigation measures considered or available but not included, with reasons why.
❒	❒	❒	❒	C.	Statement that current standard seismic designs would be used.

V. Construction Activity Impacts

All impacts associated with construction of the project are to be addressed in a "Construction Activity Impacts" section of the EIS. Provide the following information, as appropriate, for inclusion in that section:

SAT	INC	MIS	N/A		
❒	❒	❒	❒	A.	Under **Impacts**, consider temporary construction impacts such as:
❒	❒	❒	❒		1. Erosion and/or ground build-up (accretion).
❒	❒	❒	❒		2. Haul routes.
❒	❒	❒	❒		3. Requirements for sundry sites. When sundry sites (pit, waste, etc.) are anticipated, evaluate existing sites within the vicinity of the project, and any proposed new sites, and assess the impact of using these sites. For existing sites, refer to any previous environmental documentation. Base the site analysis, at least in part, on the following.
❒	❒	❒	❒		a. Aesthetic value of the site before and after construction.
❒	❒	❒	❒		b. Available sources (private, commercial, other agencies).
❒	❒	❒	❒		c. Use of waste (construct berms, flatten fill slopes, widen shoulders, sell to other agencies).
❒	❒	❒	❒		d. Sources of material (daylight cuts, flatten cut slopes, profile adjustments).
❒	❒	❒	❒		e. Presence of wetlands, flood plains, farmlands, historical or archaeological sites, or other environmentally sensitive areas.
❒	❒	❒	❒		f. Steps to be taken to minimize impacts and restore the site.
❒	❒	❒	❒		g. Size and space available for stockpile sites.
❒	❒	❒	❒		h. Impacts of on-site operation (noise, dust, and odors).
❒	❒	❒	❒		i. Cost.
❒	❒	❒	❒	B.	Under **Mitigation**, describe:
❒	❒	❒	❒		1. Mitigation measures, commitments, and monitoring procedures during construction.
❒	❒	❒	❒		2. Mitigation measures considered or available but not included.

VI. Summary

Summarize the analysis done and conclusions reached. The summary should include enough detail so that it can be included in the EIS with only minor modification.

The summary should include:

SAT	INC	MIS	N/A		
❒	❒	❒		A.	The objectives of the project.
❒	❒	❒		B.	Geologic summary of project area.
❒	❒	❒		C.	Impacts of all alternatives including the no-build alternative.
❒	❒	❒		D.	Recommended mitigation.
❒	❒	❒		E.	Comparison of alternatives based on impacts and cost effectiveness of mitigation.

General Comments: _____

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